A decorative horizontal band of wavy, translucent lines in shades of green, yellow, and brown, spanning the width of the slide.

CFSv2 Based Decadal Prediction

Edwin K. Schneider, Ioana Colfescu, COLA TEAM
and GMU Students



Team

Modeling and Research Group :

Cash, DelSole, Huang, Kinter,
Klinger, Krishnamurthy, Lu, Marx,
Schneider, Stan, Zhu

The Data Group leaded by
Jennifer Adams



Students AOES
(Data downloading) :

Colfescu, Hazra, LaJoie, Swenson



Overview

1. Decadal Prediction Research :

COLA Team and future plans

2. Preliminary Analysis :

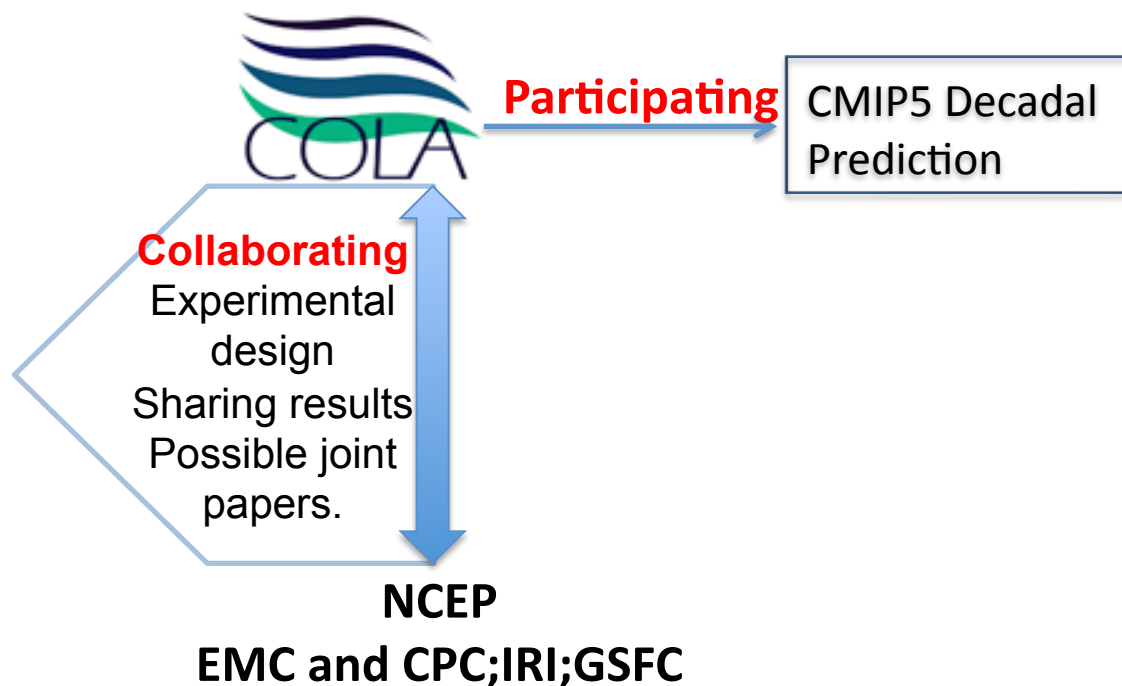
Technical Description

Models, Data and Methodology

Analysis

Decadal Predictability of Atlantic Indices
Extended interannual predictability with
better sampling

COLA CFS-based Decadal Prediction



Preliminary results

Similar to and consistent with what other groups are finding (esp. the problem of insufficient sample size which motivated a more exhaustive set of hindcasts).

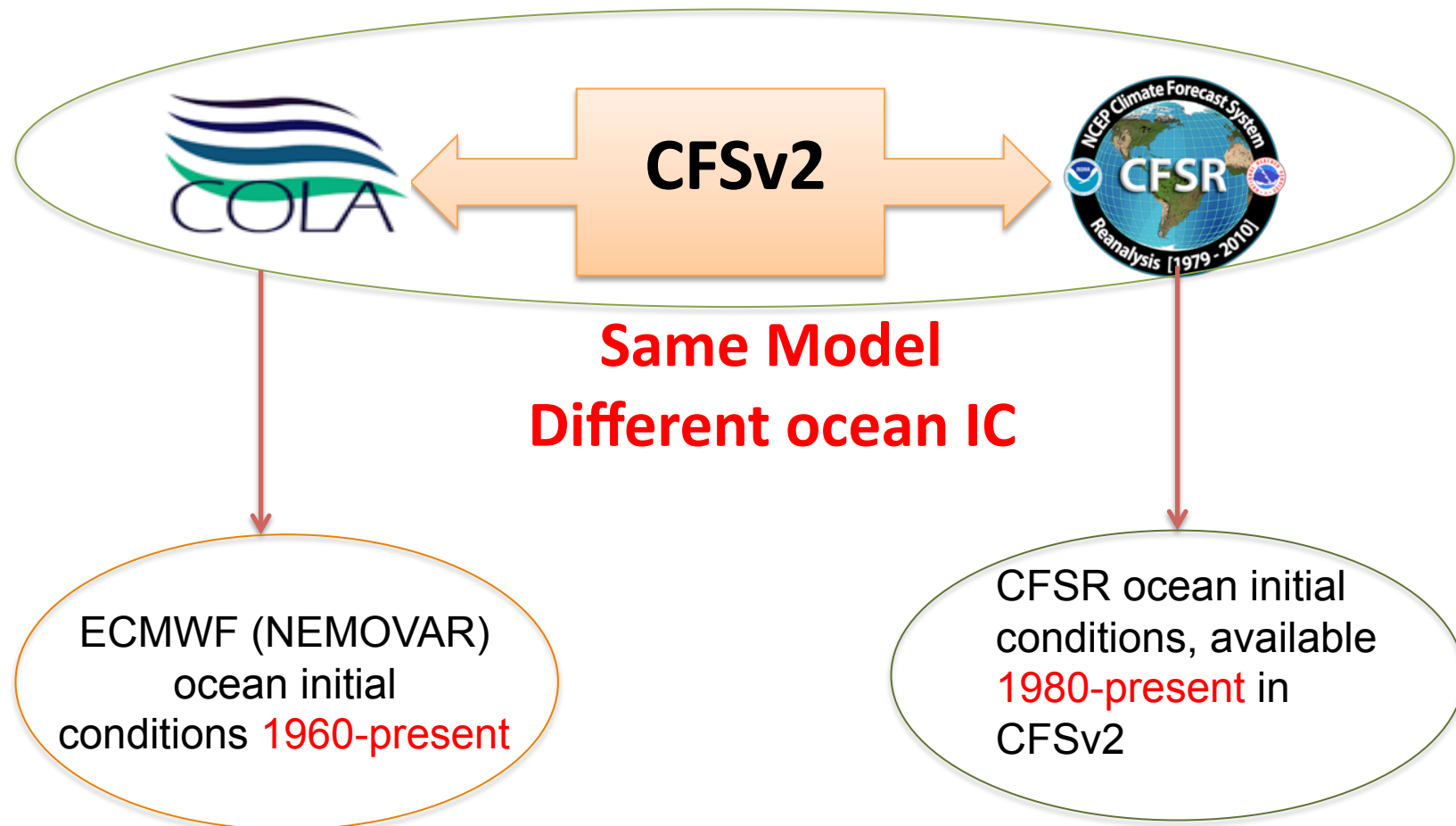
GOAL

Our goal is to use the results to establish the scientific basis for decadal prediction.

(Thanks to NCEP for providing the model, data sets and technical assistance)

RUNNING the prescribed protocol

COLA-NCEP Collaboration: CMIP5 Decadal Predictions





CFS-based Decadal Prediction

Complete and Analyze

1. Baseline runs : **CMIP5**
“core” hindcast/forecast
cases

2. Additional runs
and experiments

To address model bias issues
Improve the hindcast
To address problems with
experimental design



Seamless Prediction:

Feedback of Decadal Predictions on Shorter
Time Scale Predictions

By using for decadal prediction the same model that is used for operational seasonal prediction our results can have an impact on the way operational climate prediction is done including identifying and quantifying erroneous and/or pathological behavior of the prediction model and dependency on the ocean initialization method.



COLA CMIP5 Decadal Prediction Datasets

CCMA

CNRM

COLA.CFS

HadCM3

IPSL

MIROC.MIROC4H

MIROC.MIROC5

MPI

MRI.MRI-CGCM3

NOAA_CFS

NASA_GMAO

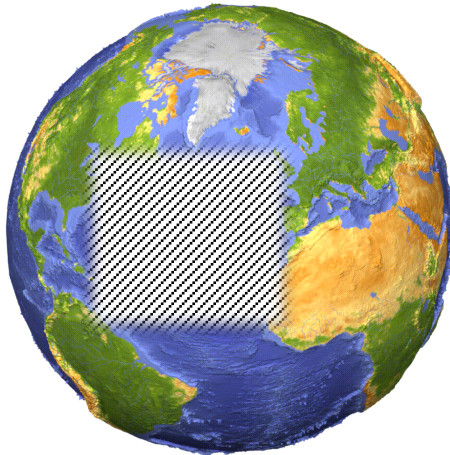
NOAA_GFDL

Additionally we have assembeled a database
of decadal predictions with

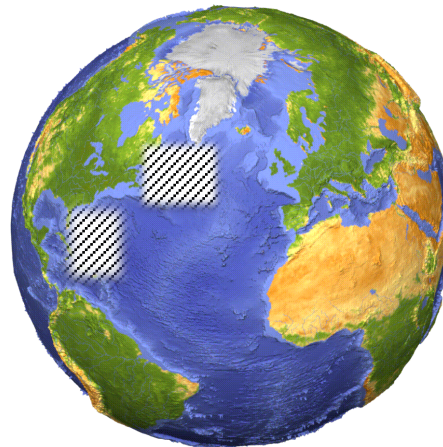
12 models

RESULTS: Predictability of Atlantic Variability Indices

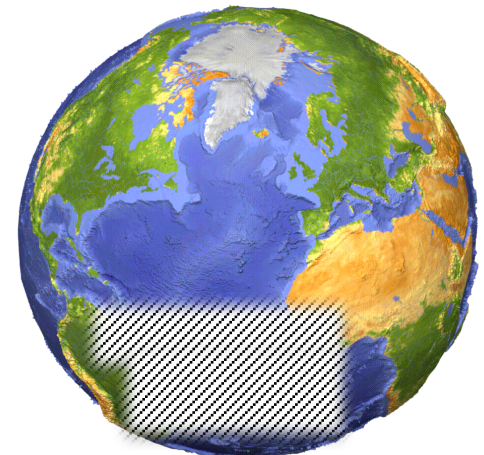
Atlantic Multidecadal Variability (AMV) :
Area average of
surface air
temperature
over ocean
(80W-0,0-59N)



North Atlantic Tripole (TRI) :
Area average of surface air
temperature over ocean
(60-40W,40-55N) minus
(80-60W,25-35N)



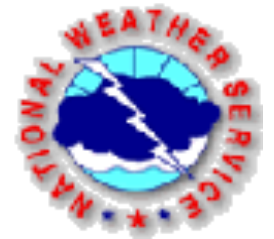
Tropical Atlantic Meridional Mode (TAMM) : Area average
of surface air
temperature over
ocean (80W-10E,
5S-20N) minus
(60W-10E,20-5S)





Technical description

- **Model**
 - CFS version 2 provided by NCEP EMC (identical to model used by NCEP for operational S-I prediction and CMIP5)
- **Initial data**
 - Atmosphere, land, sea ice: CFSR reanalysis (1980-present)
 - Ocean: NEMOVAR (ECMWF) interpolated to CFS (1960-present)
- **4-member ensembles**
 - 10 year predictions from Nov. 1960, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, 2005
- **Computer resources**
 - NASA Pleiades (Thanks to NAS)



CFS v2

- 1. An atmosphere of T126L64**
- 2. An interactive ocean with 40 levels in the vertical, to a depth of 4737 m, and horizontal resolution of 0.25 degree at the tropics, tapering to a global resolution of 0.5 degree northwards and southwards of 10N and 10S respectively**
- 3. An interactive 3 layer sea-ice model**
- 4. An interactive land model with 4 soil levels**



Predictability of Atlantic Indices: Measuring the skill of predictability

Anomaly correlation coefficient (COR)

between index of forecast ensemble mean
and observed index as a function of lead time

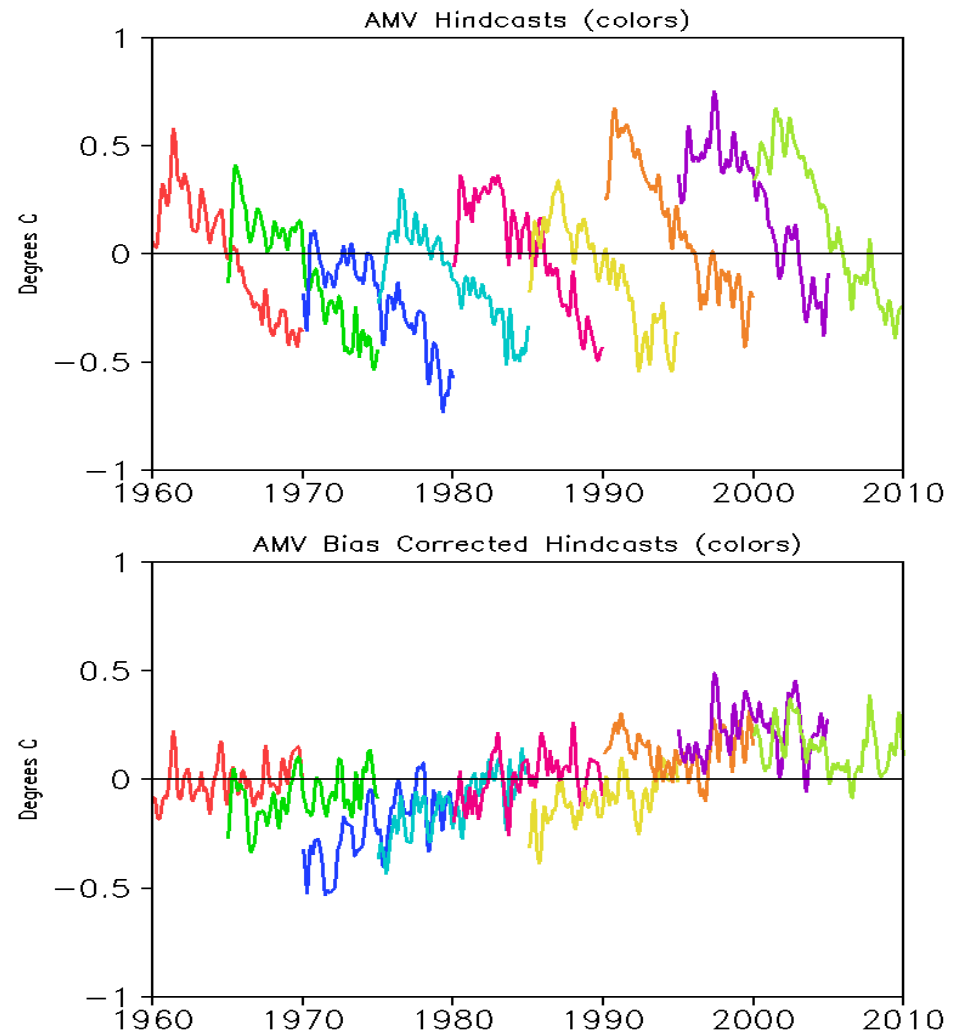
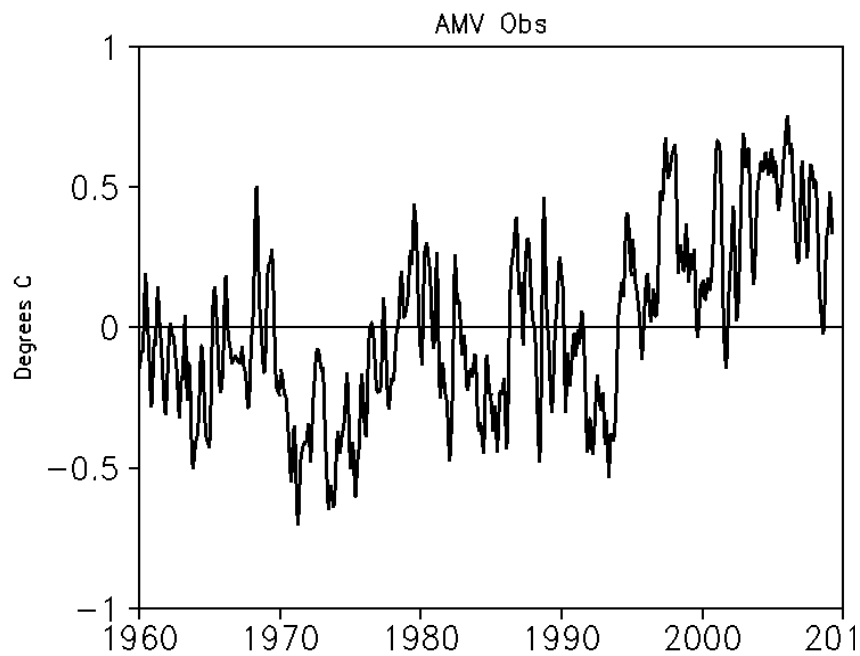
Persistence VS Dynamical Forecast

Regressions

Biases

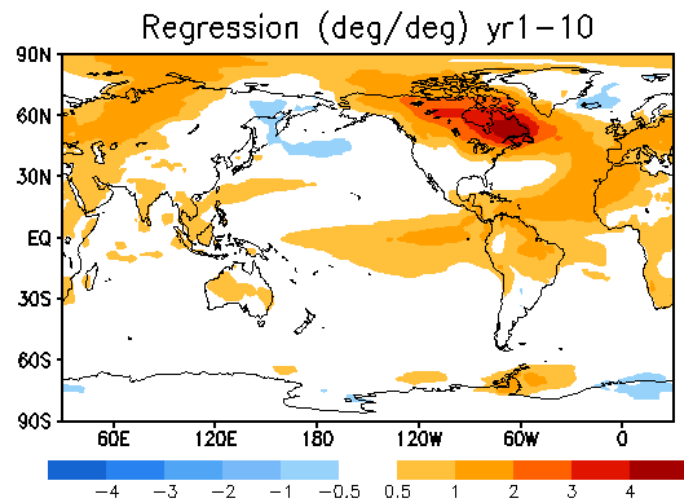
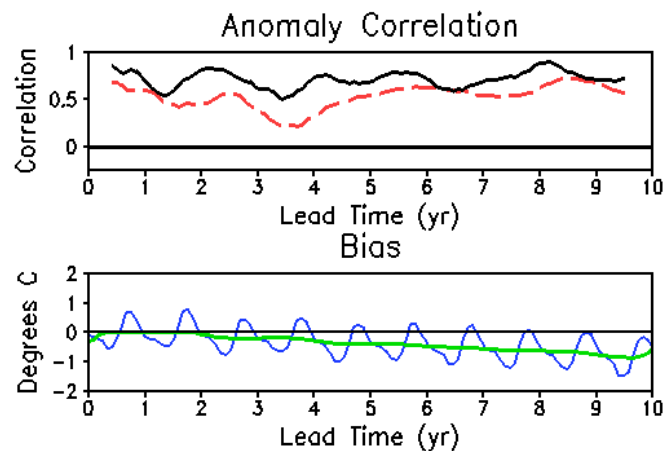


North Atlantic AMV Index



Atlantic Multidecadal Variability Index 1960-2010

ECMWF ICs



Index region
80°W-0°E, 0°N-59°N

Color key to line plots

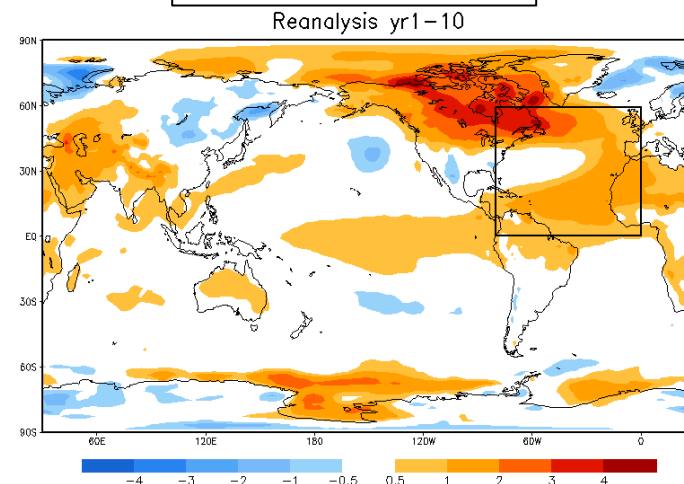
Smoothed model forecast

Smoothed persistence forecast

Model bias

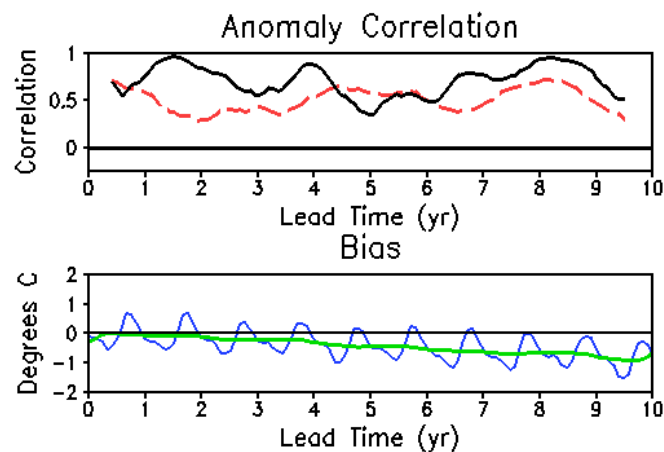
Smoothed bias

Observed

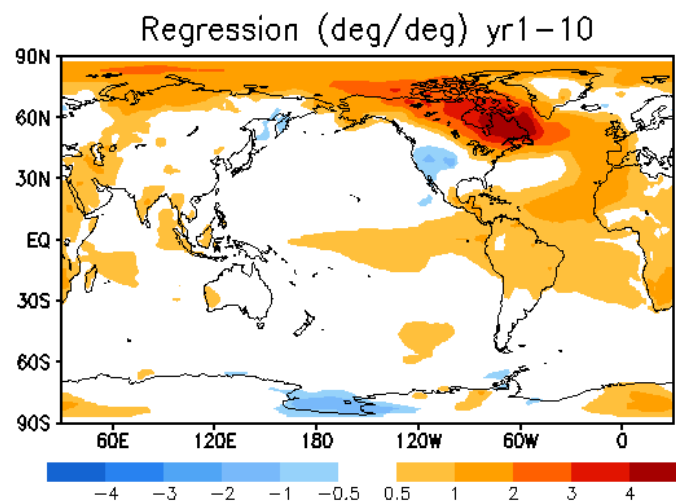
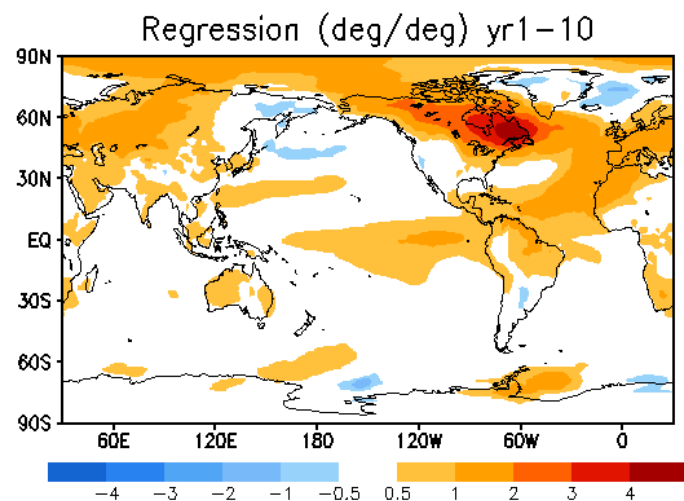
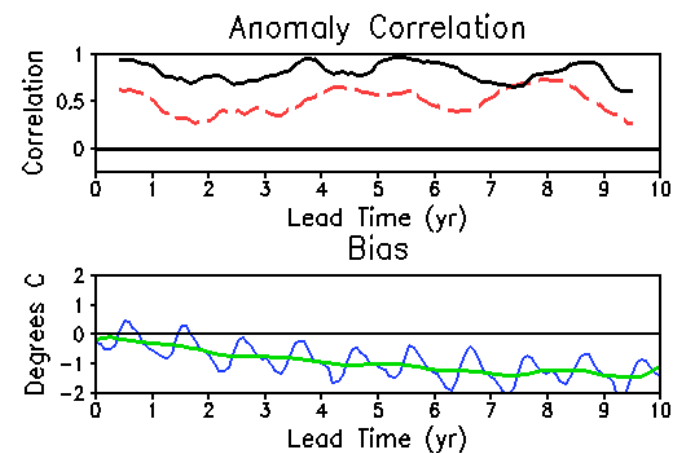


Atlantic Multidecadal Variability Index 1980-2010

ECMWF ICs

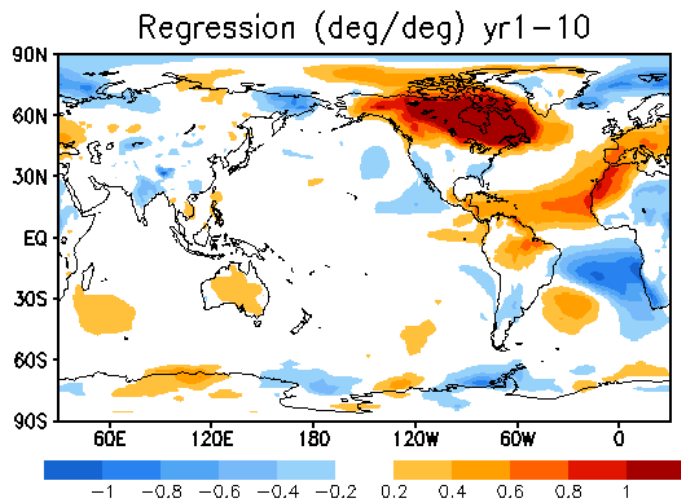
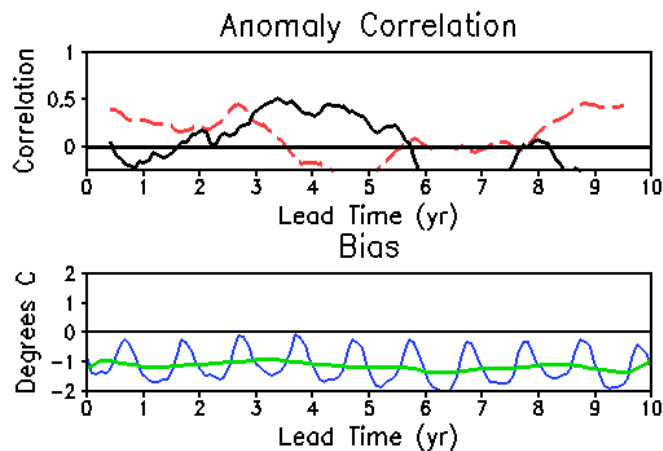


NCEP ICs



Tropical Atlantic Meridional Mode Index 1960-2010

ECMWF ICs



Index region

80°W-30°E, 5°S-20°N minus
60°W-30°E, 20°S-5°S

Color key to line plots

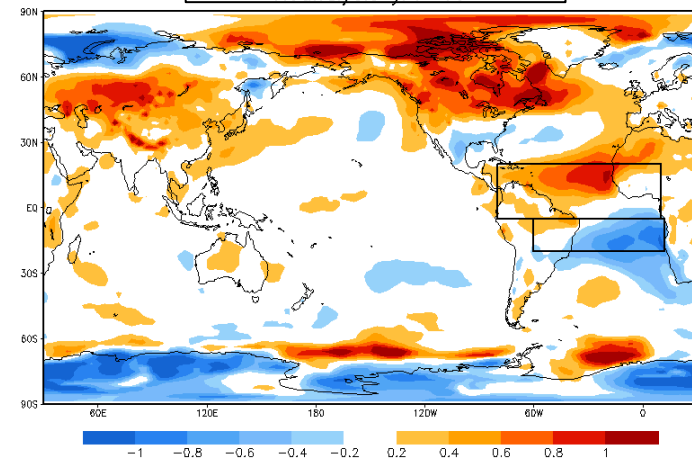
Smoothed model forecast

Persistence forecast smoothed

Model bias

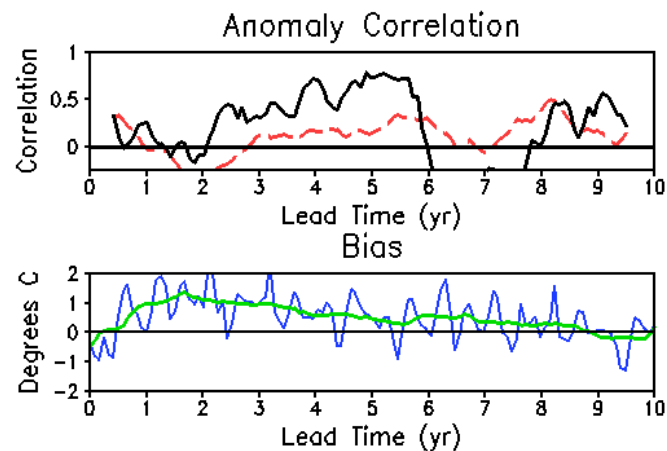
Smoothed bias

Observed
Reanalysis yr1-10



North Atlantic Tripole Index 1960-2010

ECMWF ICs



Index region

60°W-40°W, 40°N-55°N minus
80°W-60°W, 25°N-35°N

Color key to line plots

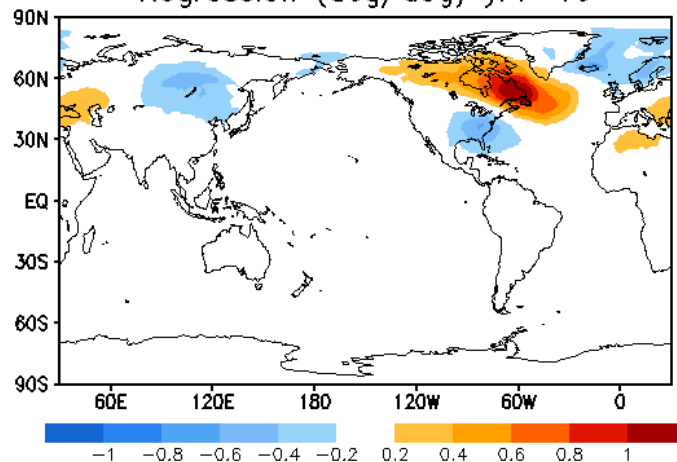
Smoothed model forecast

Persistence forecast smoothed

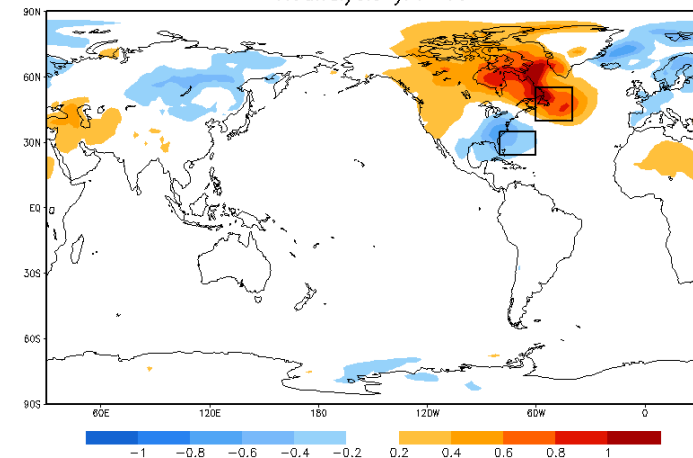
Model bias

Smoothed bias

Regression (deg/deg) yr1-10



Observed Reanalysis yr1-10

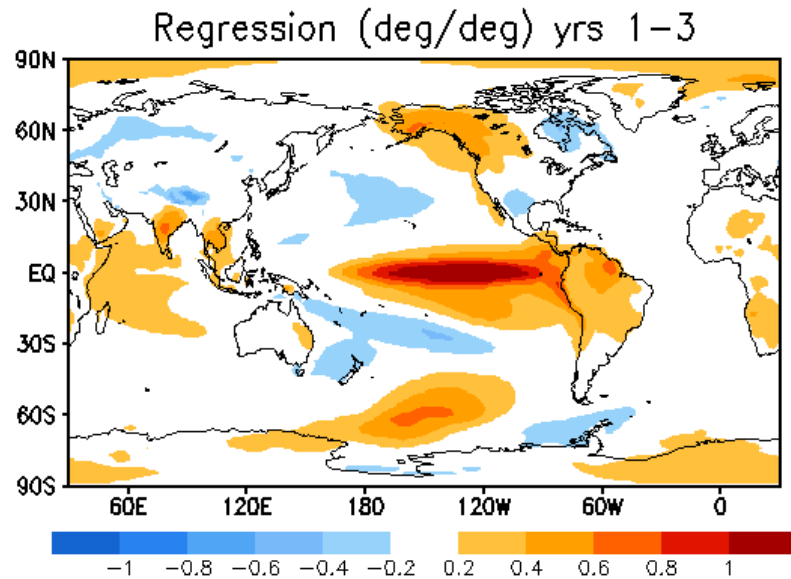
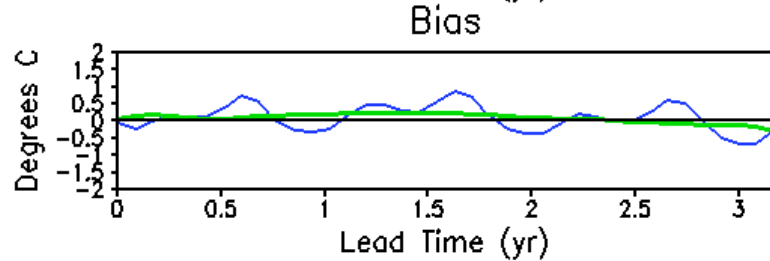
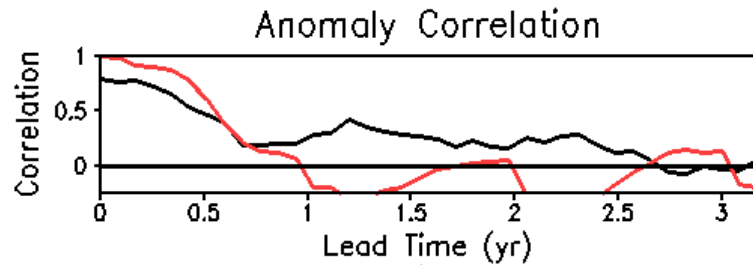




Extended NINO3.4 Predictability

- Sample of 10 decadal predictions is too small to make robust inferences about interannual or longer time scale predictability. So ...
- Fill out the cases to include at least 2 member ensembles out to 3 years lead time for all years 1960-2008.

Multiyear NINO3.4 Index 1960-2012



Index region
170°W-120°W,5°S-5°N

Color key to line plots

Model forecast

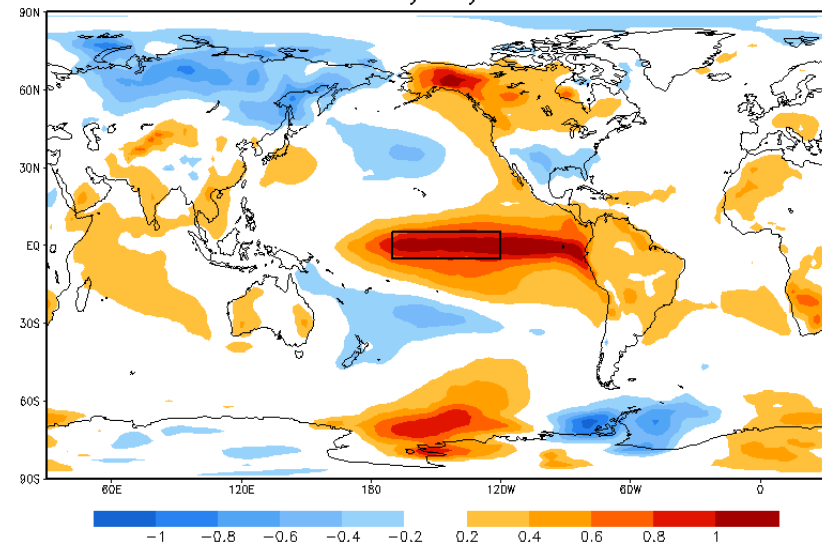
Persistence forecast

Model bias

Smoothed bias

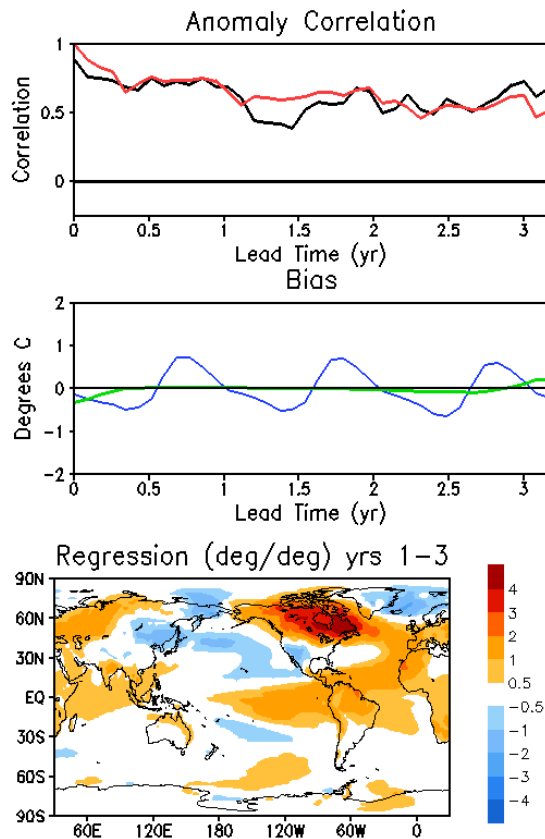
Observed

Reanalysis yr1-3

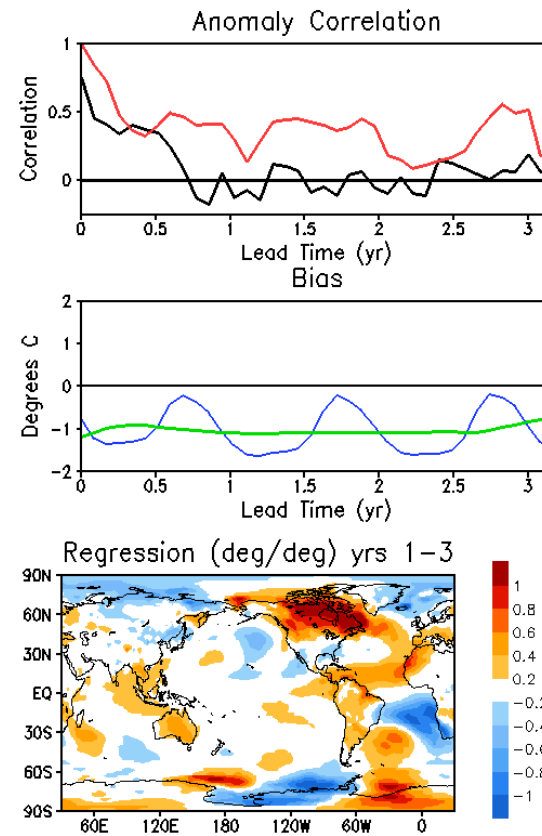


Predictability using all Years 1960-2009

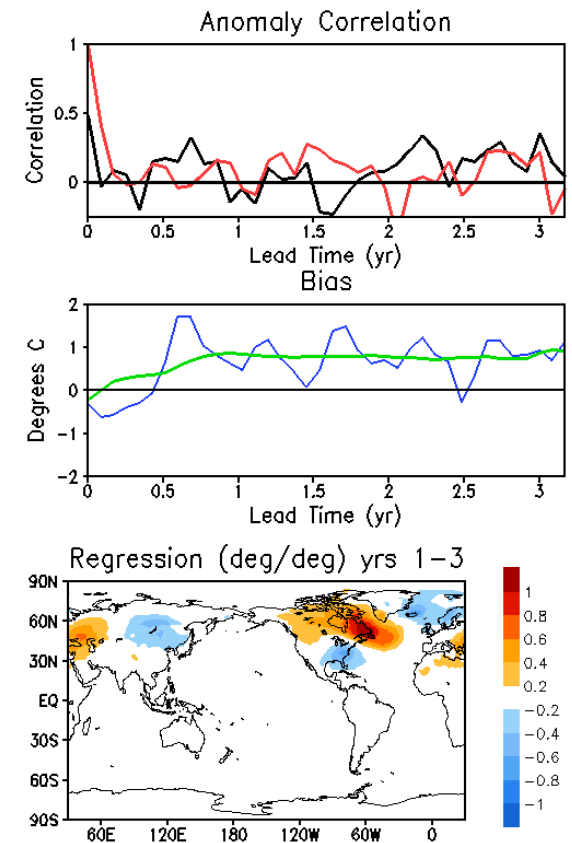
AMV



TAV



Tripole





Conclusions

AMV decadal

Dynamic Predictability better than
Persistence for approx. 7 years
Bias is negative and decreases more
abruptly in NCEP ic predictions
Regression Pattern is similar to
observed one

Extended NINO3.4 Predictability

Dynamic Predictability gets better than
persistence after the first year
Model bias varies between negative and
positive but has small values
Regression Pattern is similar to observed
one

TAV and TRIP decadal

No dynamic predictability for
decadal time scale
Model biases vary widely and can
be large
Regression patterns look realistic.

AMV , TAV and TRIP extended

Predictability is not better than
persistence
Big biases (trip and trop)
Realistic Patterns